United States Patent

O'Connor

[15] **3,692,105**

[45] **Sept. 19, 1972**

[54] **HEAT EXCHANGERS**

[72] Inventor: **Joseph M. O'Connor**, Chicago, Ill.

[73] Assignee: **Peerless of America, Incorporated**, Chicago, Ill.

[22] Filed: **Sept. 2, 1970**

[21] Appl. No.: **68,910**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 34,715, May 5, 1970, abandoned.

[52] **U.S. Cl.** **165/181**, 29/157.3

[51] **Int. Cl.** **F28f 1/16**

[58] **Field of Search** 165/171, 181, 170

[56] **References Cited**

UNITED STATES PATENTS

3,247,583 4/1966 Hansson et al. 165/171

3,294,162 12/1966 Loehlein et al. 165/181

Primary Examiner—John J. Camby
Assistant Examiner—Theophil W. Streule
Attorney—Johnston, Root, O'Keeffe, Keil, Thompson & Shurtleff

[57] **ABSTRACT**

A heat exchanger embodying an elongated tubular member with integral elongated fins extending transversely thereacross and projecting outwardly therefrom, the fins terminating at their outer longitudinal edges in spaced spines.

9 Claims, 7 Drawing Figures

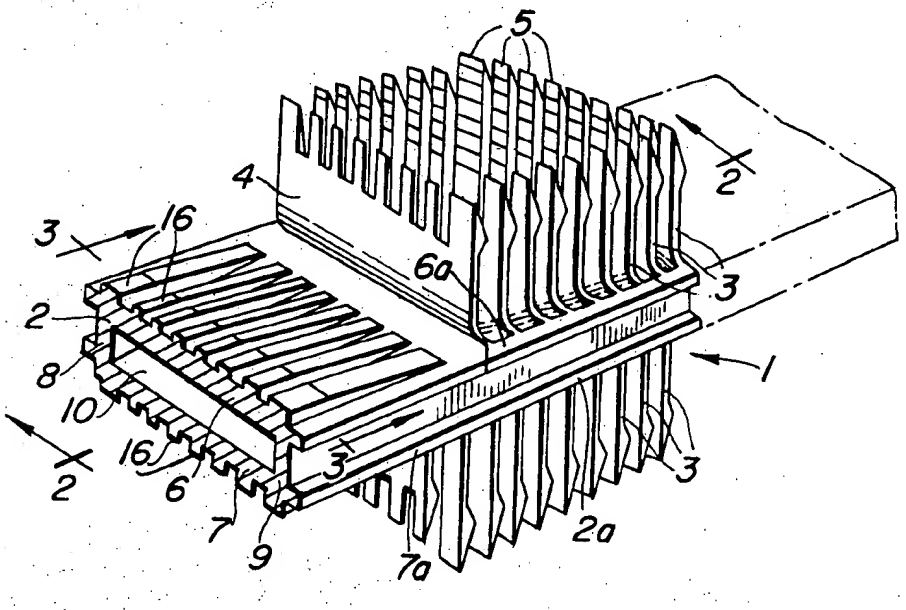


FIG 1

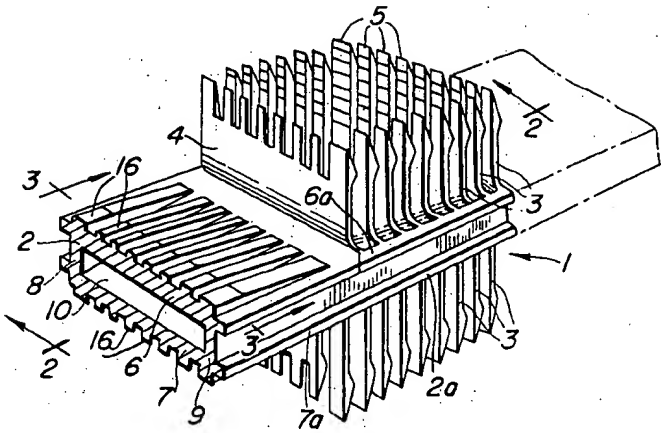


FIG 2

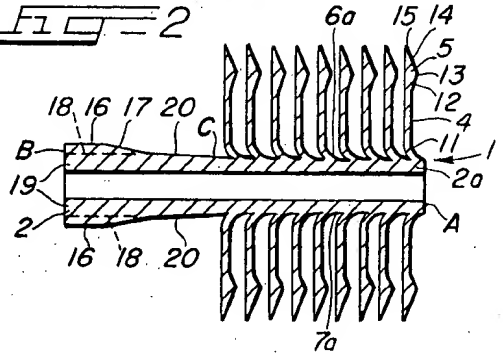
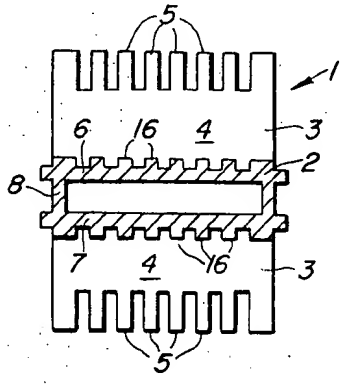


FIG 3



INVENTOR
JOSEPH M. O'CONNOR

Johnston, Root, O'Keeffe,
BY Keil, Thompson & Shurtleff

Attys

FIG. 4

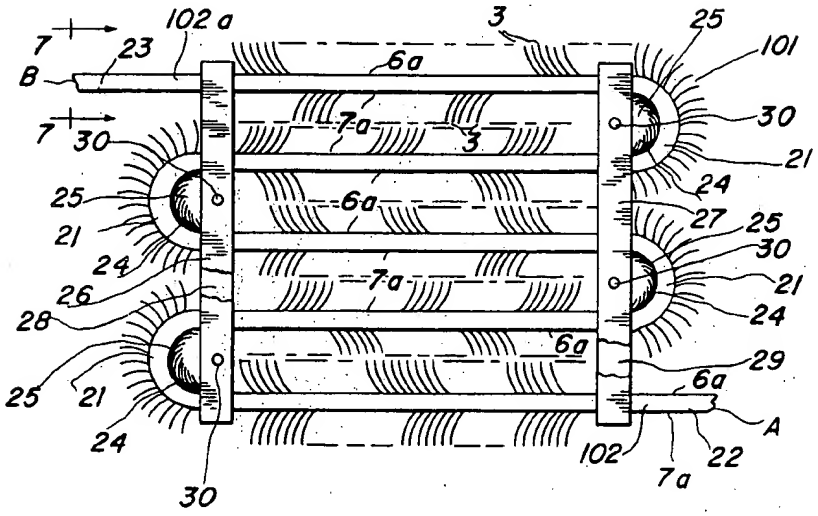


FIG. 5

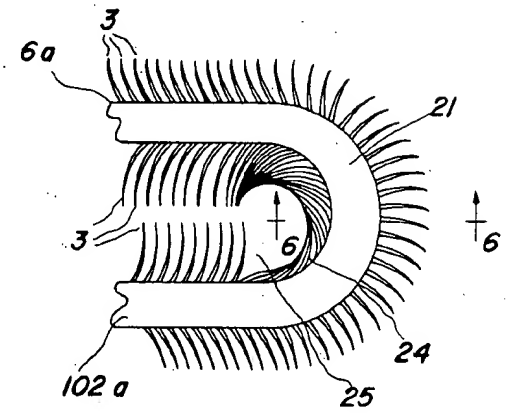


FIG. 6

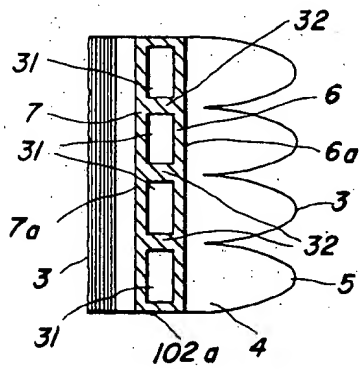
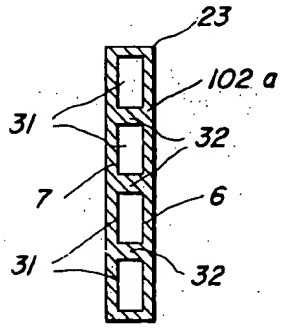


FIG. 7



INVENTOR
JOSEPH M. O'CONNOR

BY Johnston, Root, O'Keeffe, Keil, Thompson & Shurtleff
Attys

HEAT EXCHANGERS

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my earlier filed application, Ser. No. 34,715, filed in the U.S. Patent Office on May 5, 1970 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to heat exchangers, and, more particularly, to heat exchangers of the spined type.

It is a primary object of the present invention to afford a novel heat exchanger and a novel method of making the same.

Another object is to afford a novel finned heat exchanger wherein the fins are formed by cutting or gouging the same from wall portions of the heat exchanger.

Another object of the present invention is to enable a novel heat exchanger to be afforded in a novel and expeditious manner wherein secondary heat transfer surfaces may be formed by cutting or gouging them out of ribbed tubular stock to afford fins having outwardly projecting spines.

Heat exchangers embodying spines formed from outwardly projecting ribs on a tubular member have been disclosed in R. W. Kritzer U.S. Pat. No. 3,202,212. Heat exchangers of the type disclosed in the aforementioned Kritzer patent have proven to be very effective. However, it is an object of the present invention to afford improvements over heat exchangers of the type disclosed in the aforementioned Kritzer patent.

Another object of the present invention is to afford a novel heat exchanger of the spined type wherein the spines are constituted and arranged in a novel and expeditious manner.

An object ancillary to the foregoing is to afford such a heat exchanger wherein the spines are formed as an integral part of larger fin members.

A further object of the present invention is to afford a novel heat exchanger of the spaced fin type which embodies fins constituted and arranged in a novel and expeditious manner on a tubular member to afford effective reinforcing of the tubular member against distortion from internal pressures, and the like.

Another object is to afford a novel, elongated heat exchanger of the spaced fin type which embodies elongated fins extending transversely to the length of the heat exchanger in position to afford an effective reinforcing beam effect to the heat exchanger.

Another object is to enable a serpentine-shaped heat exchanger to be reinforced in a novel and expeditious manner.

Yet another object of the present invention is to afford a novel, elongated tubular heat exchanger, having reverse bends therein, wherein the bends are reinforced against necking in the outside surface thereof in a novel and expeditious manner.

A further object is to afford a novel, elongated, tubular heat exchanger having reverse bends therein, with spaced transversely extending ribs projecting from the inner and outer surfaces of the bends, and with the fins on the inner surfaces constituted and arranged in a novel and expeditious manner for the reception of fastening members through the bends.

Another object is to afford a novel heat exchanger of the aforementioned type which is practical and efficient in operation, and which may be readily and economically produced commercially.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

SUMMARY OF THE INVENTION

The present invention affords a novel heat exchanger which embodies an elongated tubular member having a wall portion from which elongated fins extend transversely thereacross and project outwardly therefrom, with spaced spines projecting outwardly from the fins so as to afford highly effective secondary heat transfer surfaces and effective reinforcing for the tubular member.

In addition, the present invention affords a novel method of making a spaced heat exchanger wherein a ribbed tubular member may be formed and fins, having outwardly projecting spines thereon, may then be formed by cutting the same from the ribs and the underlying wall portions of the tubular member and then turning the ribs outwardly away from the aforementioned wall portions.

DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of a length of heat exchanger element embodying the principles of the present invention;

FIG. 2 is a longitudinal sectional view taken substantially along the line 2—2 in FIG. 1;

FIG. 3 is a transverse sectional view taken substantially along the line 3—3 in FIG. 1;

FIG. 4 is a side elevational view of a modified form of the present invention;

FIG. 5 is an enlarged, fragmentary view of a portion of the heat exchanger shown in FIG. 4;

FIG. 6 is a detail sectional view taken substantially along the line 6—6 in FIG. 5; and

FIG. 7 is a detailed sectional view taken substantially along the line 7—7 in FIG. 4.

DESCRIPTION OF THE EMBODIMENTS SHOWN HEREIN

A heat exchanger element 1 embodying the principles of the invention, is shown in FIGS. 1–3 of the drawings as one end portion of an elongated tubular member 2, to illustrate the presently preferred embodiment of the present invention, and to illustrate the presently preferred method of making heat exchangers in accordance with the principles of the present invention.

As will be discussed in greater detail hereinafter, in the preferred practice of the present invention the heat exchanger element 1 is preferably formed from a suita-

ble length of tubular stock, such as the tubular member 2, working from one end portion A of the tubular member 2, FIG. 2, toward the other end B thereof, and severing the heat exchanger 1 from the remainder B–C of the tubular member 2 upon completion of the forming of the desired length of heat exchanger, such as the length A–C.

The heat exchanger element 1 embodies, in general, an elongated, tubular body portion 2*a* having elongated fins 3 projecting outwardly therefrom, each of the fins 3 embodying an elongated base portion 4 having a plurality of spines 5 projecting outwardly from one longitudinal edge thereof, FIG. 1.

The tubular member 2 shown in the drawings is substantially rectangular in transverse cross section, embodying a top wall 6 and a bottom wall 7 disposed in substantially parallel relation to each other, and two oppositely disposed side walls 8 and 9 extending between respective ends of the walls 6 and 7 in substantially perpendicular relation thereto. An opening 10 extends longitudinally through the tubular member 2. As will be appreciated by those skilled in the art, the tubular member 2 is shown in FIGS. 1–3 as being rectangular in transverse cross section and having a single opening 10 extending therethrough merely by way of illustration and not by way of limitation, and tubular members having shapes other than rectangular and having a plurality of openings extending longitudinally therethrough may be afforded without departing from the purview of the present invention.

In the heat exchanger 1 shown in the drawings, the fins 3 project outwardly from the outer faces of two walls 6*a* and 7*a*, FIG. 2, corresponding to, and, in fact, formed from the walls 6 and 7 of the tubular member 2, as will be discussed in greater detail presently. The fins 3 extend longitudinally across the respective walls 6*a* and 7*a* in substantially transverse relation to the length of the tubular body portion 2*a*, and each of the fins 3 embodies one of the aforementioned base portions 4, having a lower longitudinal edge portion 11 integral with the respective wall 6*a* or 7*a* to which it is attached. Each base portion 4 projects outwardly from the respective wall 6*a* or 7*a*, preferably in substantially perpendicular relation thereto, with the spines 5 thereon spaced along and projecting outwardly from the longitudinal edge of the base portion 4 remote from the body portion 2*a*. Each of the spines 5, FIG. 2, embodies a surface 12 sloping outwardly from the base portion 4 from which it projects, to afford an enlarged portion 13, and another surface 14 sloping inwardly from the enlarged portion 13 and terminating at the outer edge of the spine 5 in a thin edge 15.

The tubular member 2, from which the heat exchanger 1, shown in the drawings is made, is of any suitable material, such as, for example, aluminum, and embodies a plurality of elongated, outwardly projecting ribs 16 on the outer face of each of the side walls 6 and 7, the ribs 16 extending longitudinally of the tubular member 2 in parallel spaced relation to each other.

In making the heat exchanger 1, a tubular member such as the tubular member 2, and embodying the ribs 16 extending the full length thereof may first be formed. Thereafter, the fins 3 may be successively formed on each of the side walls 6 and 7 from one end portion of the tubular member 2, such as the end portion A toward the other end B thereof, FIG. 2. The fins 3 may each be cut or gouged from the walls 6 and 7 by means of a suitable cutting tool which first cuts along lengthwise of the ribs 16, to the right, as viewed in FIG. 2, to form the surface 17 which terminates at its lower end, as viewed in FIG. 2, at the base 18 of the ribs 16, the cutting tool then continuing to cut along lengthwise of the portion 19 of the wall 6 or 7 underlying the ribs 16, to form the surface 20, FIG. 2. The fin 3, which has been cut or gouged from the body portion 2, is then bent outwardly preferably to a position approximately perpendicular to the plane of the wall 6 or 7 on which it is formed. This gives each fin, after the first fin has been cut or gouged, the aforementioned configuration as illustrated in FIG. 2. If desired, after completion of the forming of the fins 3, the body portion 2 may be cut off to the left, as viewed in FIG. 2 of the aforementioned first fin, not shown, so that all fins 3 on the finished product have the aforementioned configuration.

After thus forming the fins 3 along the desired length of the tubular member 2, such as the length A–C, the tubular member 2 may be severed transversely to its length at the point C to thereby afford a finished heat exchanger element having fins 3 extending substantially the full length thereof. As will be appreciated by those skilled in the art, if desired, the formation of the fins 3 may be commenced inwardly of the end portion A of the tubular member 2, and the tubular member 2 may be severed outwardly to the left, as viewed in FIG. 2, of the last formed fin 3 to thereby afford end portions which project outwardly from the outermost fins 3 to afford connecting members at each end of the finished heat exchanger. In such last mentioned construction, not shown, the ribs 16 of the tubular member 2 disposed outwardly of the aforementioned outermost fins, preferably are removed by suitable means, such as, for example, grinding to thereby afford a smooth-walled end portion for the completed heat exchanger.

In FIGS. 4–7 of the drawings a heat exchanger 101 is shown to illustrate a modified form of the present invention, parts which are the same as the parts of the heat exchanger 1 shown in FIGS. 1–3 being indicated by the same reference numerals.

In the heat exchanger 101, FIG. 4, the tubular body portion 102*a* has been bent into a serpentine pattern embodying reverse bends 21. The spines 3, which project outwardly from the opposite side walls 6*a* and 7*a* of the tubular body portion 102*a* are formed in the same manner as heretofore disclosed with respect to the heat exchanger 1, while the tubular member 102, from which the tubular body portion 102*a* is formed, is in substantially straight condition, with the fins 3 being formed in spaced relation to the ends A and B of the tubular member 102, to thereby afford end portions 22 and 23 for use as connecting members at each end of the completed heat exchanger 101. If desired, the ribs 16 embodied in the tubular member 102 in its original form may be removed from the end portions 22 and 23 to thereby afford a smooth walled connecting member at each end of the heat exchanger 101.

The fins 3 may be of any desired, suitable thickness. However, preferably, in a heat exchanger of the type shown in FIGS. 4–7, the fins 3 are in the nature of ten-thousandths to thirty-thousandths of an inch thick, with the fins spaced from each other a distance of one-sixteenth to one-third of an inch, respectively.

After the tubular member **102**, with the fins **3** formed thereon has been bent into the serpentine pattern shown in FIG. **4**, the fins **3** on the inner faces of the return bends **21** may be brushed or otherwise suitably moved into compacted form, as shown at **24** in each of the return bends **21**. In such form, the fins **3** disposed along the inner curved surfaces of the return bends **21** are disposed in juxtaposition to each other to thereby afford an opening **25** through each of the return bends **21**. With this construction, suitable braces, such as the braces **26** and **27**, FIG. **4**, may be mounted on one side of the tubular body portion **102***a*, and braces **28** and **29** may be mounted on the other side of the tubular body portion **2***a* in parallel relation to the braces **26** and **27**, respectively, with suitable fastening members, such as bolts **30**, extending through the openings **25** in the return bends **21** and securing the braces **26** and **27** to the braces **28** and **29**, respectively.

It has been found that with fins, such as the fins **3**, formed on a tubular member, such as the tubular member **102**, in accordance with the principles of the present invention, the fins **3**, extending transversely across the length of the tubular member **102**, afford a reinforcing beam effect which is effective to prevent collapsing or necking in of the tubular member **102** during formation of bends therein such as the aforementioned return bends **21**, even in tubular members not embodying internal ribs.

In FIG. **4**, the tubular member **102** is shown as embodying a plurality of longitudinally extending passageways **31**. The walls **32** separating the passageways **31** are of assistance in preventing the collapse or necking in of the tubular member **102** during formation of the reverse bends **21**. However, such walls are not essential to the practice of the present invention and it will be appreciated that the heat exchanger **101** may embody a single-port tubular member, such as shown in FIGS. **1-3** without departing from the purview of the present invention.

With the heat exchanger **1** constructed in the aforementioned manner, it will be seen that the fins **4** afford secondary heat transfer surfaces, which are relatively thin and embody points and edges to thereby afford highly efficient heat transfer between the heat exchanger **1** and the atmosphere or working fluid with which it is surrounded.

In addition, it will be seen that the present invention affords a novel heat exchanger of the spined type wherein the portions of the heat exchanger to which the spines are attached not only afford good heat transfer to and from the spines, but afford effective transverse reinforcement for the tubular body portion of the heat exchanger.

In addition, it will be seen that the present invention affords a novel heat exchanger which is practical and efficient in operation and which may be readily and economically produced commercially.

Further, it will be seen that the present invention affords a novel methods of making a finned type of heat exchanger.

Thus, while I have illustrated and described the preferred embodiments of my invention, it is to be understood that these are capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. A heat transfer element comprising
- a. a tubular member having an elongated wall
- b. a plurality of fins
  - 1. spaced from each other longitudinally of said wall, and
  - 2. projecting outwardly therefrom,
- c. said fins having
  - 1. elongated base portions
    - a'. attached to said wall,
    - b'. extending transversely to the length of said wall, and
    - c'. having outer longitudinally edges, and
  - 2. a plurality of spines
    - a'. spaced along said longitudinal edges and
    - b'. projecting outwardly therefrom.

2. A heat transfer element as defined in claim 1, and in which
- a. said base portions are formed integrally with said wall.

3. A heat transfer element as defined in claim **2**, and in which
- a. said tubular member is bent back and forth upon itself to afford return bends.

4. A heat transfer element as defined in claim **3**, and in which
- a. said fins project from the outer and inner surface of said bends, and
- b. said fins on said inner surfaces are compacted together to afford openings through said bends.

5. A heat transfer element as defined in claim **4**, and which includes
- a. braces mounted on opposite sides of said bends, and
- b. fastening members extending through said openings in said bends and securing said braces together.

6. A heat transfer element as defined in claim **2**, and in which
- a. said spines have a thickness not substantially less than ten-thousandths of an inch and not substantially more than thirty-thousandths of an inch.

7. A heat transfer element as defined in claim **1**, and in which
- a. each of said base portions has an outer longitudinal edge, and
- b. said spines on each respective said base portion project outwardly from said longitudinal edge thereof.

8. A heat transfer element as defined in claim **7**, and in which
- a. said spines are formed integrally with said respective base portion from which they project.

9. A heat transfer element as defined in claim **8**, and in which
- a. said spines
  - 1. terminate at the sides thereof remote from said respective base portion from which they project in a thin edge,
  - 2. taper outwardly from said respective base portion to an enlarged portion, and
  - 3. taper inwardly from said enlarged portion to said thin edge.

* * * * *